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**PRELIMINARY CRUISE RESULTS  
NOAA SHIP MILLER FREEMAN  
CRUISE NO. 95-04**

**COMBINED ECHO INTEGRATION-TRAWL SURVEY  
AND FOCI RESEARCH EFFORT OF WALLEYE POLLOCK IN SHELIKOF STRAIT**

**CRUISE PERIOD, AREA, AND SCHEDULE**

Scientists from the Alaska Fisheries Science Center (AFSC) and the Pacific Marine Environmental Laboratory (PMEL) conducted an echo integration-trawl (EIT) survey (Acoustics Group) and recruitment study [Fisheries-Oceanography Coordinated Investigations (FOCI) Group] directed at walleye pollock (Theragra chalcogramma) in the Shelikof Strait area, Gulf of Alaska. The research was conducted aboard the NOAA ship Miller Freeman from March 15 to April 1, 1995, for a total of 16 sea days. Areas of operation included the Shumagin Islands and Shelikof Strait areas. The cruise began in Dutch Harbor. During the latter portion of the cruise, a generator failure suspended trawling operations until the vessel was repaired in Kodiak. Changes in the scientific party were also made in Kodiak. The cruise ended when the vessel passed through Unimak Pass to begin work in the Bering Sea during MF95-05.

The itinerary for the Miller Freeman was as follows:

March 15	Embark scientists in Dutch Harbor
March 16	Conduct one bongo tow in the Shumagin Islands. Cancel planned trawl hauls on spawning pollock aggregations due to bad weather--proceed to Shelikof Strait
March 18-24	Conduct EIT survey of Shelikof Strait area
March 24	Occupy FOCI Line 8 stations

March 24-26	Resume EIT survey of Shelikof Strait area
March 26-27	Suspend trawl operations because of generator failure; complete echo integration portion of EIT survey; transit to Kodiak
March 28-29	Arrive Kodiak for generator repair; exchange portion of scientific party
March 30	Depart Kodiak
March 31- April 1	Complete trawl portion of EIT survey; transit to Bering Sea

### OBJECTIVES

The primary objectives of the cruise were to:

1. collect echo-integrator data and midwater and bottom trawl data necessary to determine the distribution, biomass, and biological composition of walleye pollock in the areas of operations;
2. collect various meteorological and physical oceanographic data including vertical profiles of temperature and salinity at selected sites, and continuous monitoring of near-surface currents, temperature, salinity, light levels, etc;
3. collect stomach samples from pollock and other fish species which are considered potential predators of pollock;
4. continue acquisition of long-term biological and physical time series;
5. collect age-0 pollock samples for diet and physiological condition studies;
6. spawn mature pollock and rear the eggs for larval studies in Seattle, Washington, and Newport, Oregon; and
7. collect mature pollock ovaries for fecundity studies.

### VESSEL, ACOUSTIC EQUIPMENT, AND TRAWL GEAR

The survey was conducted on board the NOAA ship Miller Freeman,

a 66-m (216-ft) stern trawler equipped for fisheries and oceanographic research. Acoustic data were collected with a quantitative echo-sounding system (Simrad EK500<sup>1</sup>). The Simrad 38 and 120 kHz split-beam transducers were mounted on the bottom of the vessel's centerboard. Results presented in this document are based on 38 kHz data. With the centerboard fully extended, the transducers were 9 m below the water surface. System electronics were housed in a portable laboratory mounted on the vessel's weather deck. Data from the Simrad EK500 echo sounder/receiver were stored and processed using the Simrad BI500 echo-integration and target-strength data collection and analysis software on a SUN workstation.

Midwater echosign was sampled using a modified Northern Gold 864 midwater rope trawl (NET Systems, Inc., Bainbridge Island, Washington). The trawl was constructed with ropes in the forward section and stretch mesh sizes ranging from 163 cm (64 in) immediately behind the rope section to 8.9 cm (3.5 in) in the codend. It was fished in a bridleless configuration and was fitted with a 3.2-cm (1.25-in) mesh codend liner. Length of the headrope was 94.5 m (310 ft) when measured between the attachment points at the breastline. Length of the footrope was 50 m (164 ft) when measured between the tom weight attachment points. The breastlines measured 79.4 m (260.5 ft). The net was fished with 1.8-m X 2.7-m (6-ft X 9-ft) steel V-doors [1,000 kg (2,200 lb)] and 227-kg (500-lb) tom weights on each side. Vertical net opening, depth, and temperature at depth were monitored with a Furuno wireless net sounder system attached to the headrope of the trawl.

Fish on and near bottom were sampled with a polyethylene Nor'eastern high-opening bottom trawl equipped with roller gear. The trawl was constructed with stretch mesh sizes that ranged from 13 cm (5 in) in the forward portion of the net to 8.9 cm (3.5 in) in the codend. It was fitted with a nylon codend liner with a mesh size of 3.2 cm (1.25 in). The 27.2-m (89.1-ft) headrope held 21 floats [30 cm (12 in) diameter]. A 24.7-m (81-ft) chain fishing line was attached to the 24.9-m (81.6-ft) footrope which was constructed of 1-cm (0.4-in) 6 x 19 wire rope wrapped with polypropylene rope. The 24.2-m (79.5-ft) roller gear was constructed with 36-cm (14-in) rubber bobbins spaced 1.5-2.1 m (5-7 ft) apart. A solid string of 10-cm (4-in) rubber disks separated some of the bobbins in the center section of the roller gear. Two 5.9-m (19.5-ft) wire rope extensions with 10-cm

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<sup>1</sup>Reference to trade names or commercial firms does not constitute U.S. Government endorsement.

(4-in) and 20-cm (8-in) rubber disks were used to span the two lower flying wing sections and were attached to the roller gear. The roller gear was attached to the fishing line using chain toggles [2.9 kg (6.5 lb) each] which were comprised of five links and one ring. The trawl was rigged with triple 54.9-m (180-ft) galvanized wire rope dandyline. The net was fished with 1.8-m X 2.7-m (6-ft X 9-ft) steel V-doors [1,000 kg (2,200 lb)]. Vertical net opening, depth, and temperature at depth were monitored with a Furuno wireless net sounder system attached to the headrope of the trawl.

Vertical profile measurements of water temperature and salinity were collected at most trawl stations using a Seabird CTD (conductivity/temperature/depth) system. Temperature profile data were also collected by attaching micro bathythermographs (MBT) to most trawls. At several sites expendable bathythermographs (XBT) were used. The acoustic Doppler current profiler was slaved to the EK500 and operated continuously throughout the cruise in the water profiling mode.

#### **SURVEY METHODS**

An echo integration-trawl survey was conducted in the Shelikof Strait area to assess the distribution, abundance, and biological characteristics of pollock. (The "Shelikof Strait area" refers to Shelikof Strait and the area surveyed between Middle Cape and Chirikof Island.) Survey transects were oriented parallel to one another. Transects were spaced about 14 km (7.5 nmi) apart except along the western side of the Strait, where 7 km (3.75 nmi) spacing was used (Fig. 1). Greater sampling effort was allocated to the western side of the Strait since it has historically contained most of the pollock spawning biomass. Transects generally did not extend into waters less than about 75 m in depth.

Survey operations were conducted 24 hours a day. Vessel speed averaged about 11 kts while conducting transects, although it varied between 5 and 13.5 kts depending upon weather conditions. Survey operations were scheduled to begin near Chirikof Island but severe weather required skipping transect lines between Chirikof Island and Middle Cape, which were instead completed at the end of the survey.

The acoustic system was used to collect echo-integration and in situ target-strength data during survey operations. Estimates of absolute pollock abundance will be derived from the former data after they are appropriately scaled.

Midwater and bottom trawl hauls were made at selected locations to identify echosign and provide biological samples. Average trawling speed was about 3 kts. The vertical net opening for the midwater rope trawl averaged about 23 m (range 19-30 m). The Poly Nor'eastern trawl's vertical mouth opening was about 5 m (range 4-6 m).

Standard catch sorting and biological sampling procedures were used to provide weight and number by species for each haul. Pollock were further sampled to determine sex, fork length (FL), age, maturity, and body and ovary weights. An electronic scale was used to determine all weights taken from individual pollock specimens. Fish lengths were usually taken with a Polycorder measuring device (a combination of a bar code reader and a hand held computer). Stomachs were collected from pollock, Pacific cod, and Arrowtooth flounder and were preserved in 10% formalin. Fecundity samples were removed from mature females and preserved in Gilson's solution. Adult pollock were successfully spawned, and the fertilized eggs were transported to Seattle and Newport, where various studies utilizing pollock eggs and larvae are conducted.

### PRELIMINARY RESULTS

A zig-zag trackline pattern was run near Unimak Pass after departing Dutch Harbor to locate trawlable aggregations of spawning pollock to collect eggs and milt for rearing experiments. No fishable echosign was found. One bongo net tow was conducted in the Shumagin Islands area. Eggs were caught in the tow, suggesting that spawning had recently occurred. Bad weather, however, forced the cancellation of planned trawl hauls on spawning pollock aggregations.

The survey then proceeded to Shelikof Strait, where acoustic data were collected between March 15-27 and comprised about 2,232 km (1,205 nmi) of tracklines (Fig. 1). Nineteen trawl hauls were conducted from March 15-26 (Table 1). A generator breakdown on March 26 suspended trawling operations through the completion of the survey track line on March 27. After repairs were made in Kodiak, six additional trawl hauls were conducted during March 31-April 1 in the southern strait area.

A distributional plot of acoustic backscattering attributed primarily to pollock greater than age 1 is presented in Fig. 2. (Acoustic backscatter collected completely south of Middle Cape has not yet been differentiated between adult pollock and age 1 pollock.) The densest adult pollock aggregations were broadly

distributed near Capes Kekurnoi and Kuliak along the west side of the Strait (Fig. 1), where historically the greatest densities of pollock have been observed during surveys conducted in March. Most fish were detected within 50-100 m of the bottom. Age 1 pollock echosign was often detectable in a well-defined, mid-water layer about 150-200 m below the surface from Uyak Bay to the southern limits of the surveyed area near Chirikof Island (Fig. 3).

Pollock was the dominant fish species captured in midwater trawl hauls, comprising 89.5% by weight and 82.0% by numbers of the total catch (Table 2). Eulachon (Thaleichthys pacificus) was the next most common species caught and was primarily associated with tows where the dominant catch by numbers were age 1 pollock. Pollock ranked first in numbers and weight among fishes captured in bottom trawl hauls, comprising 95.5% and 90.9%, respectively (Table 3). Arrowtooth flounder (Atheresthes stomias) was the next most common species caught in bottom trawl hauls.

Biological data were collected at 22 midwater and 3 bottom trawl locations (Tables 1 and 4, Fig. 1). In 15 of the 22 midwater tows, the numbers of age 1 pollock exceeded the catch of older pollock, including all 9 tows conducted south of Middle Cape (Table 1). Age 1 pollock were the dominate catch by weight in 5 tows. Tows made near Cape Kuliak (Hauls 6-10) caught mostly adult pollock, while tows conducted elsewhere caught varying amounts of age 1 (9-15 cm), age 2 (17-30 cm), and older pollock (31-65 cm)(Fig. 4). The size composition of pollock caught in the 3 bottom trawl hauls was similar to nearby mid-water tows, with modal lengths around 48 cm FL and few age-1 pollock.

A total of 2,735 pollock were sampled for maturity from the demersal and midwater catches during the survey. No females less than 31 cm FL or males less than 32 cm FL were mature (Fig. 5). The mean gonadosomatic index (GSI), defined as the ratio of gonad weight to total body weight for mature females, was 0.15 (Fig. 6). The highest numbers of spawning females were observed in the vicinity of Cape Kuliak, where 35% of the adult females were judged to be in spawning condition. Outside of this area, only 5% of the adult females were judged to be in spawning condition.

A total of 10 successful CTD casts, 19 MBT casts, and 4 XBT casts were made during the Acoustics Group's operations (Tables 5-7, Fig. 7). FOCI line 8 time series stations were occupied on March 24, but because of time and weather constraints, only five of eight sites were sampled.

**SCIENTIFIC PERSONNEL**

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